SECTION 18260
STRUCTURAL WELDER PERFORMANCE QUALIFICATION TESTS FOR TARGET BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements for the qualification of welders and welding operators on-site in accordance with AWS D-1.1 or D-1.3.

1.2 RELATED SECTIONS

A. Section 18100A, General Welding Requirements for Target Building and Beam Dumps Systems.

B. Section 05120, Structural Steel.

C. Section 05121, Stainless Steel.

D. Section 18250, Structural Welding Procedure Specifications.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. See Section 18100A, General Welding Requirements for Target Building and Beam Dumps Systems.

PART 3 - EXECUTION

3.1 TEST REQUIREMENTS

A. CM and Contractor welders test to the standard PQTs described in this specification which require the use of WPSs from Section 18250.

B. PQTs are intended to determine the ability of welders to make sound welds in accordance with a qualified welding procedure.

C. Each welder and welding operator must pass a PQT prior to welding on components or assemblies which are fabricated in accordance with the AWS D-1.1 or D-1.3 Code. Qualify welders and welding operators either to the requirements of this section or to the requirements of ASME Sect, IX (see Section 18630).

D. After each welder or welding operator successfully completes the requirements of a test, assign an identification number, letter, or symbol to be used to identify work performed by the welder or welding operator. If the welder was previously qualified, use the active identification.

E. Welders who pass qualification tests for groove welds are qualified for groove welds within the limits of the test description and for fillet welds of any thickness. Additionally, the groove weld test on plate qualifies welders for groove welds on structural pipe only to the extent shown in Table 5.5 of AWS D-11.

3.2 RETESTS

A. A welder who fails to meet requirements of a test may be retested under either of the following conditions.
   1. An immediate retest may be made consisting of two test welds of each type and for each position on which tests failed to meet requirements. The test requirements for the original test apply.
   2. A retest may be made provided there is evidence the welder has had a minimum of 2-h additional training or practice. Make a complete retest of the types and positions failed.

B. The test supervisor determines the conditions for retest as required by paragraph 3.2 A.

3.3 RENEWAL OF QUALIFICATION

A. A welder or welding operator maintains a qualification by welding with the process or by performing a renewal test (update) in accordance with paragraph 3.3 B. If not maintained, the qualification is revoked.

B. The renewal qualification test is required under the following conditions:
   1. When the welder has not used the welding process (manual shielded metal arc, gas tungsten arc, etc.) for a period of more than 6 months but less than 1 y or
   2. When there is specific reason to question the welder's ability to produce welds that meet specification requirements.

C. The renewal test requires the welder to successfully complete one test on the smallest diameter material previously qualified to weld in the most restrictive position using that process. Failure of this test requires the welder to requalify for each performance qualification test needed for that process.

D. Qualifications expired for longer than a year must complete each performance qualification test needed.

E. The ability of welders or welding operators to meet specification requirements may be questioned by the test supervisor or his designee at any time.

3.4 TEST DESCRIPTION

A. Each test description defines the requirements to be followed in performance of tests in accordance with the qualified WPS.

B. Each test description specifies the mechanical tests and/or other tests required in order to pass the test.

C. Tests are generally written to qualify welders for all positions. Welders may qualify for limited positions. Use Table 1 to determine the position restrictions.

3.5 TESTS AND ACCEPTANCE STANDARDS

A. Visual Examination.
   1. The completed test assembly shall be visually examined by the test supervisor and meet the criteria of AWS D-1.1, Paragraph 5.28.6.

B. Mechanical Testing

1. When bend tests are used to qualify welders, use the testing and acceptance criteria in AWS D-1.1, Paragraphs 5.27.1 and 5.28.1, respectively.

C. Radiographic Testing
   1. When radiographic testing is used to qualify welders, use the technique specified in Paragraphs 5.26.5 and 5.27.4 of AWS D-1.1. The acceptance criteria in Paragraph 5,28.4 of AWS D-1.1 apply.

D. Macroetch Testing
   1. When macroetch testing is used to qualify welders, use the technique and acceptance criteria in AWS D-1.1, Paragraphs 5.27.3 and 5.28.3, respectively.

Table 1. Matrix to determine positions qualified

Work performed to AWS D-1.3 (Div. 18, Structural)

Code type test	Position(s) passed	Fillet welds		Groove welds		
		Plate Position	Pipe (any size) Position	Plate & pipe >24 in. Position	Pipe Diam (OD)	Pipe Position
AWS D-1.1 Plate	1G	F, H	F, H	F	N/A	N/A
	2G	F, H	F, H	F, H	N/A	N/A
	3G	F, H, V	F, H	F, H, V	N/A	N/A
	4G	F, H, O	F	F, O	N/A	N/A
	3G, 4G	All	All	All	N/A	N/A
AWS D-1.1 Plug Welds	1F	1F	N/A	N/A	N/A	N/A
	3F	3F	N/A	N/A	N/A	N/A
	4F	4F	N/A	N/A	N/A	N/A
AWS D-1.1 2-in. (NPS) Pipe	2G	F, H	F, H	F, H	≤4.500	F, H
	5G	F, V, O	F, V, O	F, V, O	≤4.500	F, V, O
	2G, 5G	All	All	All	≤4.500	All
	6G	All	All	All	≤4.500	All

Work performed to AWS D-1.3 (Div. 18, Structural)

Code type test	Position(s) passed	Fillet welds		Groove welds		
		Plate Position	Pipe (any size) Position	Plate & pipe >24 in. Position	Pipe Diam (OD)	Pipe Position
AWS D-1.3	1G	N/A	N/A	F	N/A	N/A
	2G	N/A	N/A	H	N/A	N/A
	3G	N/A	N/A	V	N/A	N/A
	4G	N/A	N/A	O	N/A	N/A
	1F	F	N/A	N/A	N/A	N/A
	2F	H	N/A	N/A	N/A	N/A
	3F	V	N/A	N/A	N/A	N/A
	4F	O	N/A	N/A	N/A	N/A

PQT/WPS CROSS REFERENCE

PQT	WPS	THICKNESS		MIN. DIAM OD	COMMENTS
		MIN MATERIAL (WPS)	MAX DEPOSIT		
FC-6-L	FC11-1(ST)	0.125	0.750	>24	
FC-6-LA	FC11-2(ST)	0.125	0.750	>24	Self-Shielding Wire
FC-6-U	FC11-1(ST)	0.125	Unlimited	>24	
GM-6-L	GM11-1(ST)	0.125	0.750	>24	
GM-6-U	GM11-1(ST)	0.125	Unlimited	>24	
SM-4-LA	SM11-1(ST)	0.125	0.674	4.500	Diam is MAX.
	SM11-2(ST)	0.125	0.674	4.500	Diam is MAX.
SM-4-L	SM11-1(ST)	0.125	0.750	>24	
	SM11-2(ST)	0.125	0.750	>24	
SM-4-U	SM11-1(ST)	0.125	Unlimited	>24	
	SM11-2(ST)	0.125	Unlimited	>24	
SM-4-PLUG	SM11-1(ST)	0.125	Unlimited	>24	Plug Welds Only
SM-3-O-1	SM11-2(ST)	0.125	0.436	1.000	See Sect. 18360
SM-3-O-2	SM11-2(ST)	0.125	0.750	2.875	See Sect. 18360
SM-4-B-1	SM11-1(ST)	0.125	0.436	1.000	See Sect. 18360
	SM11-2(ST)	0.125	0.436	1.000	See Sect. 18360
SM-4-B-2	SM11-1(ST)	0.125	0.750	2.875	See Sect. 18360
	SM11-2(ST)	0.125	0.750	2.875	See Sect. 18360
SM-3-1-ASW	SMASW-1(ST)	18 Gage	18 Gage	Sheet	Arc Spot Welds
SM-3-2-ASW	SMASW-2(ST)	20 Gage	20 Gage	Sheet	Arc Spot Welds

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: FC-6-L REVISION 1

1.	WELDING PROCESS:	FCAW (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E71T-1
3.	BASE MATERIAL:	Carbon Steel Plate, 3/8 in. thick X 6 in. wide (min) X 7 in. long (min) per Fig. 5.21 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	FC11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	One face bend and one root bend test from each test position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	FCAW
2.	ELECTRODE/FILLER METAL:	F6 (SFA/A 5.20)
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through 3/4 in.

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: FC-6-LA		REVISION 0
1.	WELDING PROCESS:	Flux Cored Arc Welding (FCAW) (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E71T-7, E71T-8, or E71T-11
3.	BASE MATERIAL:	Carbon Steel Plate, 3/8 in. thick X 6 in. wide (min) X 7 in. long (min) per Fig. 5.21 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	FC11-2(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	One face bend and one root bend test from each test position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	FCAW
2.	ELECTRODE/FILLER METAL:	F6 (SFA/A 5.20) self-shielding classifications only
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through 3/4 in.

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: FC-6-U REVISION 1

1.	WELDING PROCESS:	FCAW (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E71T-1
3.	BASE MATERIAL:	Carbon Steel Plate, 1 in. thick X 6 in. wide (min) X 5 in. long (min) per Fig. 5.19 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	FC11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	Two side bend tests from each test position per AWS D-1.1, para. 6; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	FCAW
2.	ELECTRODE/FILLER METAL:	F6 (SFA/A 5.20)
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through unlimited

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GM-6-L REVISION 1

1.	WELDING PROCESS:	GMAW (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E70S-3 or E70S-6
3.	BASE MATERIAL:	Carbon Steel Plate, 3/8 in. thick X 6 in. wide (min) X 7 in. long (min) per Fig. 5.21 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	GM11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	One face bend and one root bend test from each test position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	GMAW except short-circuiting transfer
2.	ELECTRODE/FILLER METAL:	F6 (SFA/A 5.18)
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through 3/4 in.

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GM-6-U REVISION 1

1.	WELDING PROCESS:	GMAW (Manual)

2.	ELECTRODE/FILLER MATERIAL:	E70S-3 or E70S-6
3.	BASE MATERIAL:	Carbon Steel Plate, 1 in. thick X 6 in. wide (min) X 5 in. long (min) per Fig. 5.19 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	GM11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	Two side bend tests from each test position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	GMAW except short-circuiting transfer
2.	ELECTRODE/FILLER METAL:	F6 (SFA/A 5.18)
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through unlimited

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-4-LA REVISION 1

1.	WELDING PROCESS:	SMAW
2.	ELECTRODE/FILLER MATERIAL:	E7018

3.	BASE MATERIAL:	Carbon Steel Pipe, 2 in. NPS, Sch 80 (0.218 in. W.T.) per Fig. 5.24 of AWS D-1.1
4.	WELDING POSITION(S):	2G and 5G, or 6G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	SM11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	One face and one root bend test from the 2G position; two face and two root bend tests from the 5G and 6G position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	SMAW
2.	ELECTRODE/FILLER METAL:	F1 through F4 of AWS D-1.1, para. 5.16.3
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS ($\leq$4 IN. DIAM)	All except full pen welds in structural tubing
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through 0.674 in.

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-4-L REVISION 1

1.	WELDING PROCESS:	SMAW (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E7018
3.	BASE MATERIAL:	Carbon Steel Plate, 3/8 in. thick X 6 in. wide (min) X 7 in. long (min) per Fig. 5.21 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	SM11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	One face bend and one root bend test from each test position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	SMAW
2.	ELECTRODE/FILLER METAL:	F1 through F4 of AWS D-1.1, para. 5.16.3
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through 3/4 in.

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-4-U REVISION 1

1.	WELDING PROCESS:	SMAW (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E7018
3.	BASE MATERIAL:	Carbon Steel Plate, 1 in. thick X 6 in. wide (min) X 5 in. long (min) per Fig. 5.19 of AWS D-1.1
4.	WELDING POSITION(S):	3G and 4G
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	SM11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	Two side bend tests from each test position per AWS D-1.1, para. 5.26; or, radiographic examination per AWS D-1.1, para. 5.27.4

LIMITS OF QUALIFICATION:

1.	PROCESS:	SMAW
2.	ELECTRODE/FILLER METAL:	F1 through F4 of AWS D-1.1, para. 5.16.3
3.	POSITION(S):	
	a. PLATE AND SHAPES:	
	GROOVE WELDS	All
	FILLET WELDS	All
	b. PIPE AND TUBE:	
	GROOVE WELDS (>24 IN. DIAM)	All
	FILLET WELDS (ANY DIAM)	All
4.	JOINT TYPES:	Groove welds with backing or backgouged, partial penetration welds, and fillet welds
5.	BASE METAL THICKNESS:	1/8 in. through unlimited

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-4-PLUG REVISION 1

1.	WELDING PROCESS:	SMAW (Manual)
2.	ELECTRODE/FILLER MATERIAL:	E7018
3.	BASE MATERIAL:	Carbon Steel Plate, 3/8 in. thick test coupon configuration per Fig. 5.29 of AWS D-1.1
4.	TEST COUPON POSITION(S):	1F, 3F, 4F (see Table 5.5 of AWS D-1.1)
5.	VERTICAL WELDING PROGRESSION:	Upward
6.	WELDING PROCEDURE:	SM11-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.1, para. 5.28.6
8.	TEST(S):	Two macroetch specimens from each test position per AWS D-1.1, para. 5.28.3 and Fig. 5.29. Both specimens are obtained from one welded coupon

LIMITS OF QUALIFICATION:

1.	PROCESS:	SMAW
2.	ELECTRODE/FILLER METAL:	F1 through F4 of AWS D-1.1, para. 5.16.3
3.	POSITION(S):	All
4.	JOINT TYPES:	Plug welds only
5.	BASE METAL THICKNESS:	1/8 in. through unlimited

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-3-1-ASW		REVISION 0
1.	WELDING PROCESS:	SMAW (Manual) Arc Spot Welding
2.	ELECTRODE/FILLER MATERIAL:	E6010
3.	BASE MATERIAL:	18 Gage A446 galvanized (G-90 coating thickness) and 1/2 in. thick A36 plate. Dimensions and configuration of test coupon per Fig. 6.2 of AWS D-1.3
4.	WELDING POSITION(S):	1G
5.	VERTICAL WELDING PROGRESSION:	N/A
6.	WELDING PROCEDURE:	SMASW-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.3, para. 4.5.2
8.	TEST(S):	Weld 2 coupons each for welds through single and double thickness sheet per Fig. 6.2 of D-1.3. Destructively test per para. 6.7.2.1(1) of D-1.3. A weld nugget of at least 1/2 in. diam is required

LIMITS OF QUALIFICATION:

1.	PROCESS:	SMAW (Arc Spot Welds Only)
2.	ELECTRODE/FILLER METAL:	F3 (E6010 Only)
3.	POSITION(S):	Flat
4.	JOINT TYPES:	Arc spot welds on structural backing
5.	BASE METAL THICKNESS:	
	a. Sheet Steel	18 Gage; single or double thickness
	b. Backing Steel	1/8 in. through unlimited

STRUCTURAL WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-3-2-ASW		REVISION 0
1.	WELDING PROCESS:	SMAW (Manual) Arc Spot Welding
2.	ELECTRODE/FILLER MATERIAL:	E6010
3.	BASE MATERIAL:	20 Gage A446 galvanized (G-90 coating thickness) and 1/2 in. thick A36 plate. Dimensions and configuration of test coupon per Fig. 6.2 of AWS D-1.3
4.	WELDING POSITION(S):	1G
5.	VERTICAL WELDING PROGRESSION:	N/A
6.	WELDING PROCEDURE:	SMASW-1(ST)
7.	INSPECTION:	Visual examination per AWS D-1.3, para. 4.5.2
8.	TEST(S):	Weld 2 coupons each for welds through single and double thickness sheet per Fig. 6.2 of D-1.3. Destructively test per para. 6.7.2.1(1) of D-1.3. A weld nugget of at least 1/2 in. diam is required

LIMITS OF QUALIFICATION:

1.	PROCESS:	SMAW (Arc Spot Welds Only)
2.	ELECTRODE/FILLER METAL:	F3 (E6010 Only)
3.	POSITION(S):	Flat
4.	JOINT TYPES:	Arc Spot welds on structural backing
5.	BASE METAL THICKNESS:	
	a. Sheet Steel	20 Gage; single or double thickness
	b. Backing Steel	1/8 in. through unlimited

END OF SECTION 18260